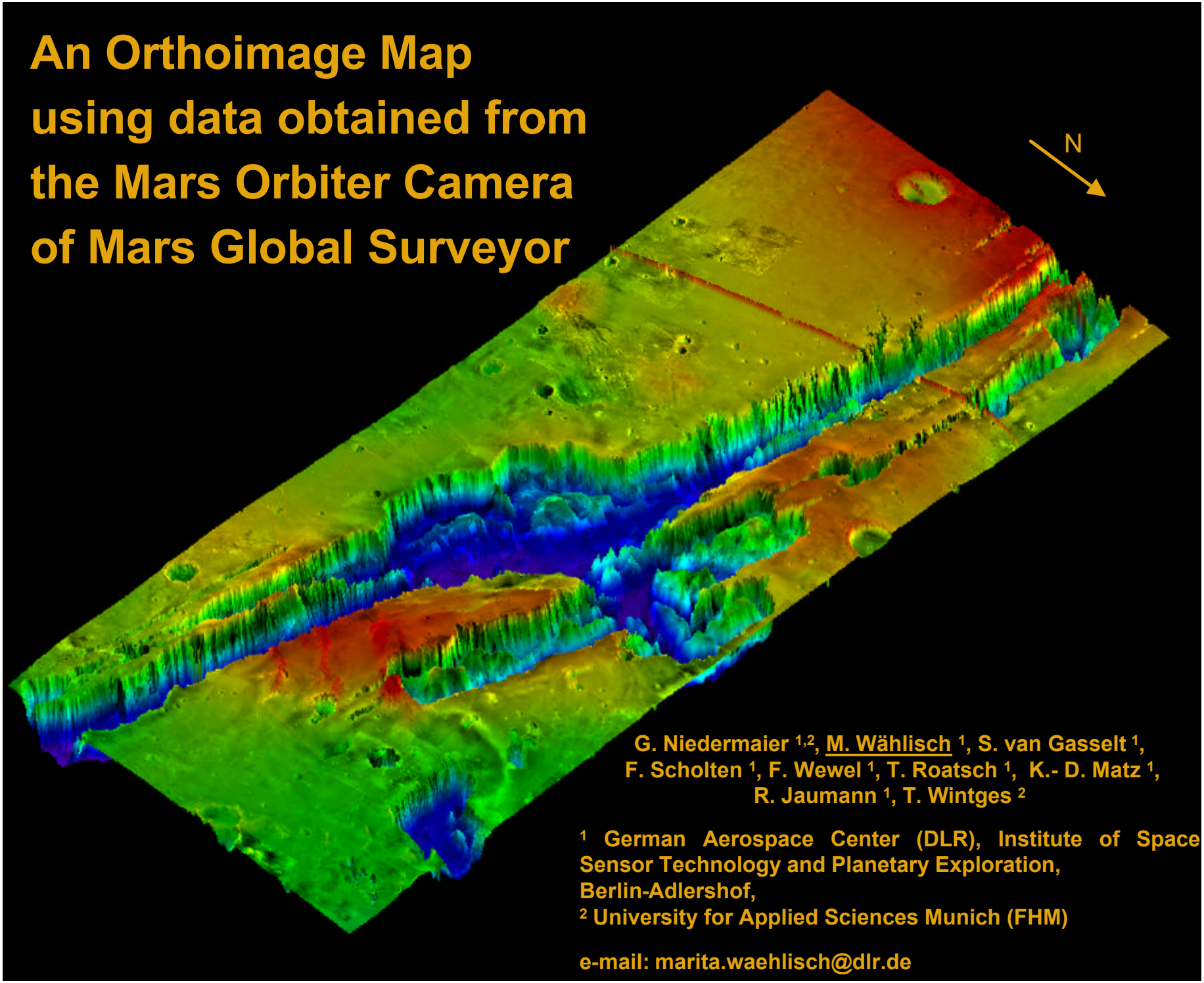
An Orthoimage Map using data obtained from the Mars Orbiter Camera of Mars Global Surveyor



G. Niedermaier [1,2], M. Wählisch [1], S. van Gasselt [1], F. Scholten [1], F. Wewel [1], T. Roatsch [1], K.- D. Matz [1], R. Jaumann [1], T. Wintges [2]

[1] German Aerospace Center (DLR), Institute of Space Sensor Technology and Planetary Exploration, Berlin-Adlershof,
[2] University for Applied Sciences Munich (FHM)

e-mail: marita.waehlisch@dlr.de

Institute of Space Sensor Technology and Planetary Exploration

INTRODUCTION.

A basic requirement for the planning of future, perhaps even manned, Mars missions are precise and high resolution maps of our neighbor planet and, especially, of the landing site area. Here, we present a new orthoimage map of Mars using data obtained from the Mars Orbiter Camera (MOC) of the Mars Global Surveyor (MGS).

The new map covers the Mars surface from 0° to 180° West and from 60° South to 60° North with a resolution of 231.529 m/pixel. Digital image processing methods have been developed and applied for the production of image mosaics and a hardcopy map. These methods can be used for the creation of image mosaics using CCD line camera data and is also applicable for other Mars missions, whenever a CCD line camera is used.

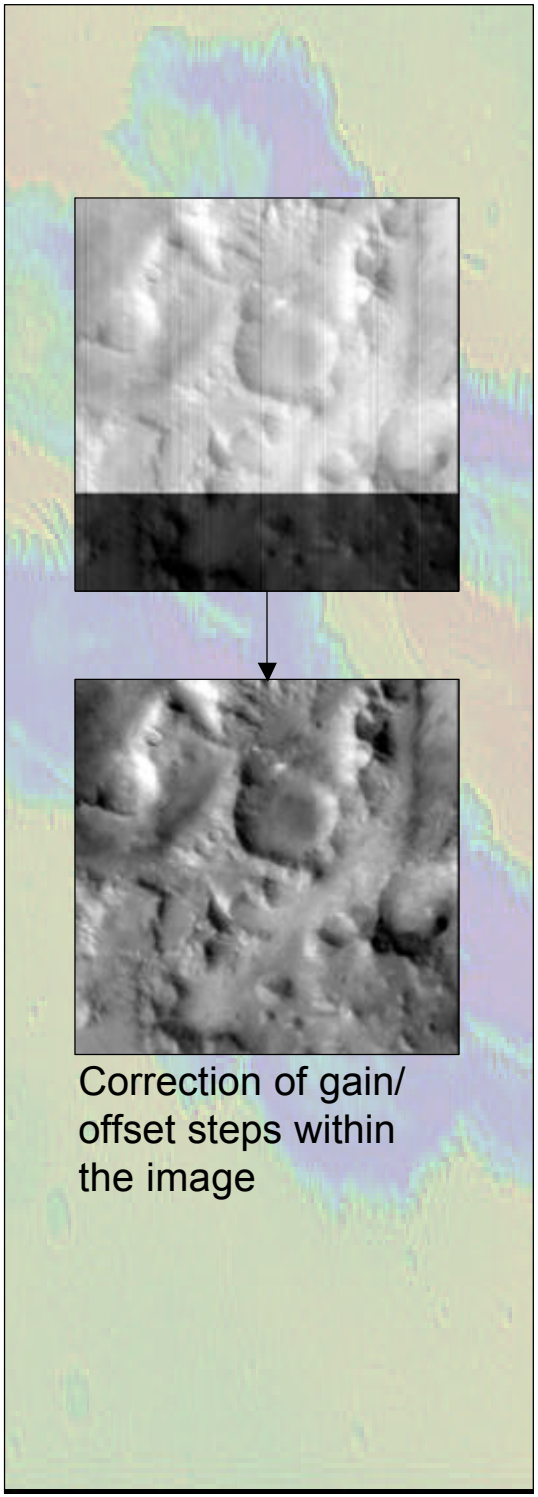
METHODS.

Image data processing has been performed using multiple VICAR[1] and IDL programs, developed by the JPL[2], DLR[3] and the TUB[4]. Furthermore, ISIS[5] software, developed by the USGS[6], was applied (*see flowchart diagram on page 5*).

First, each MOC image was corrected for radiometric camera errors. After visual inspection, some images were edited manually to remove image artifacts (stripes of pixel errors, etc.). Images containing too many artifacts, were not included. The correction of images with major differences in brightness was performed using IDL software developed at the DLR.

Often, images of the Geodesy Campaign show black, white or gray starting lines, which were eliminated automatically after radiometric correction, during the conversion to 8 bit images. Consequently, the overlap of the map projected images is not guaranteed always. Black gaps between the north/south border of the large stripes of the Geodesy Campaign occur.

1: Video Image Communication and Retrieval; 2: Jet Propulsion Laboratory; 3: German Aerospace Center; 4: Technical University of Berlin; 5: Integrated Software for Imagers and Spectrometer; 6: U.S. Geological Survey



Correction of gain/ offset steps within the image

After all radiometric and brightness corrections, the images were Mars referenced, geometrically corrected and map projected using a global Martian Digital Terrain Model (DTM), developed by the DLR and based on MGS Mars Orbiter Laser Altimeter (MOLA) data.

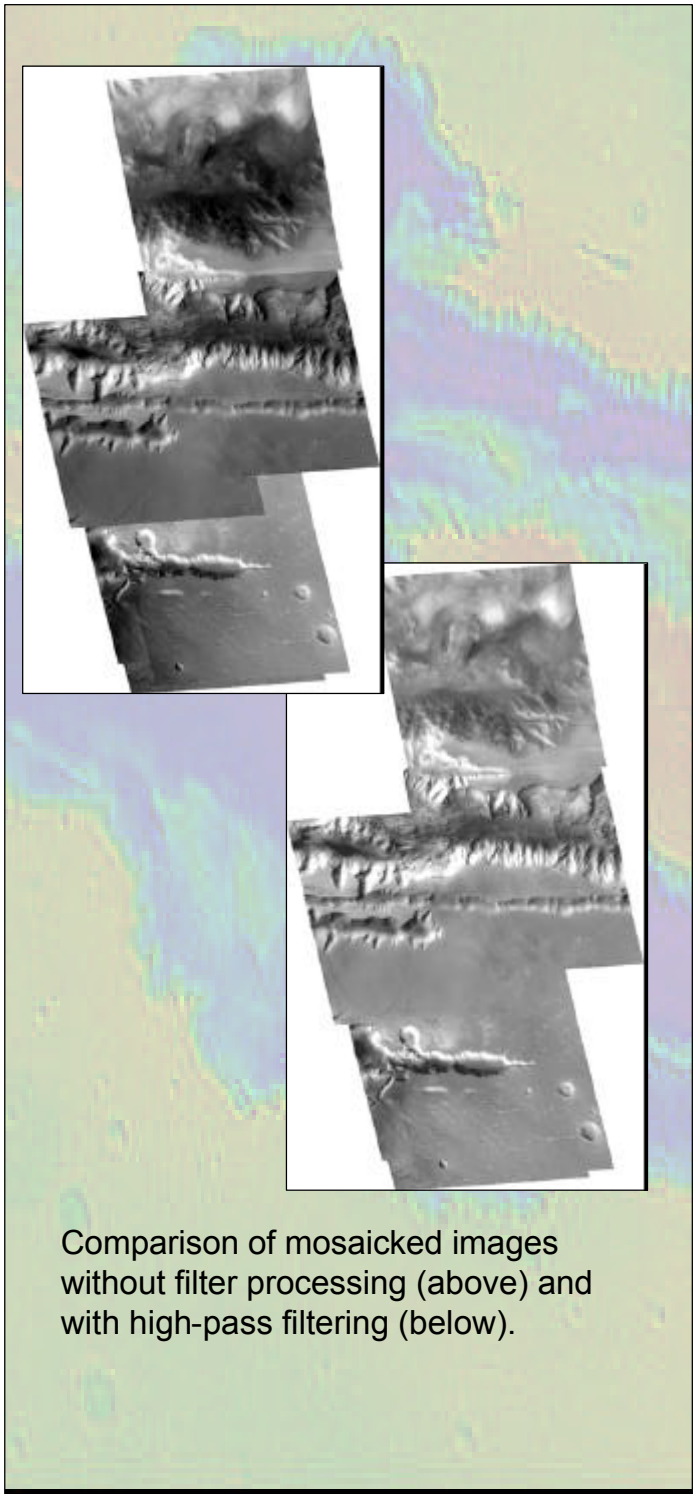
In order to keep distortions at an acceptable level, the images were sinusoidal map projected using 45° W as well as 135° W as reference meridian.

To eliminate major differences in brightness between the individual images of the mosaics, high- and low-pass filter processing techniques were applied for each image (see examples on the right side).

Obviously, the data range of the recently obtained MOC context images is better than the data range of images of the Geodesy Campaign itself.

To take advantage of the 8 bit data range of the MOC camera, we decided to use not only the long strips (e.g., 4° x 17°) of the Geodesy Campaign, but all available context images (2° x 2°).

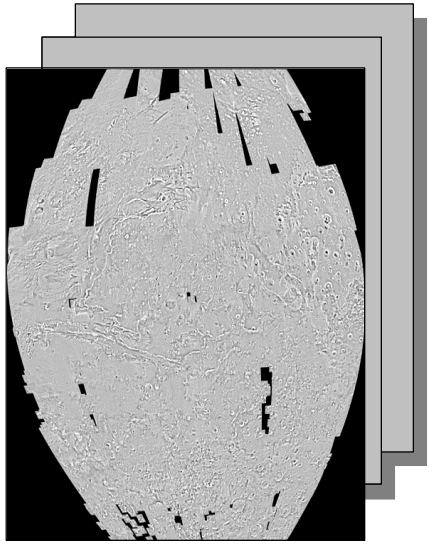
Additionally, we sorted the images of the Geodesy Campaign depending of their resolution (below 250 m/Pixel). Finally, we created three layers of MOC mosaics (*see next page*), which were stacked afterwards. A few gaps in the coverage were filled with Mars Digital Image Mosaics (MDIM2), based on 7 bit VIKING-Data.



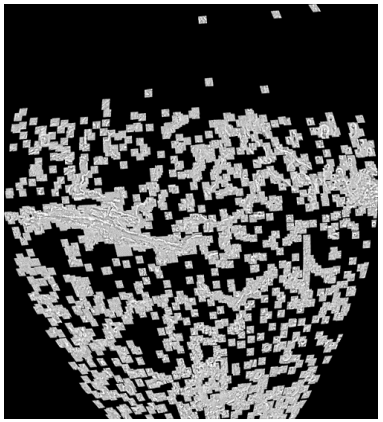
Comparison of mosaicked images without filter processing (above) and with high-pass filtering (below).

Stacking

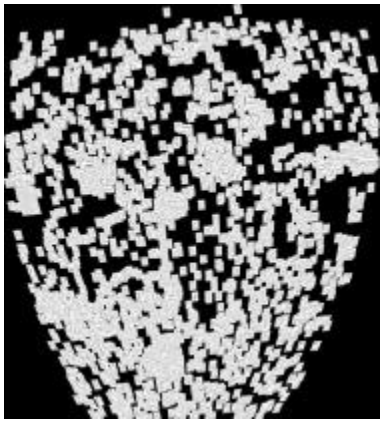
Images between a latitude range of 20°-60° N contain resolutions of > 250 m/pixel to < 435 m/pixel, only.

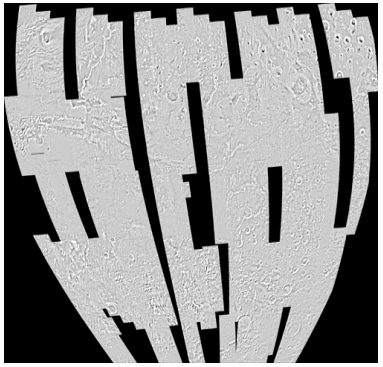


0° to 90° West

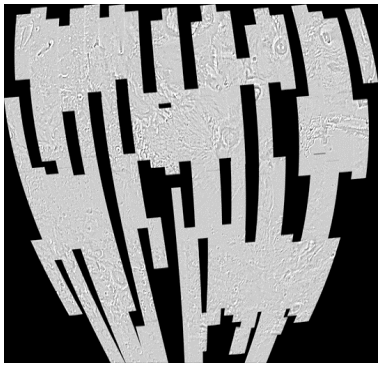


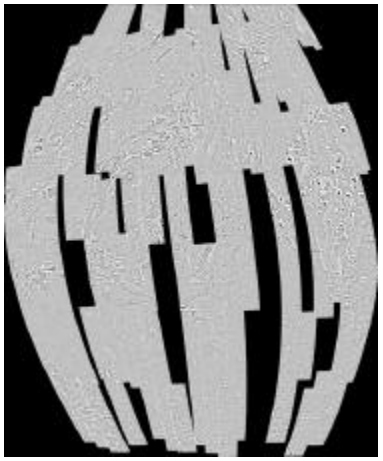
upper layer context images, resolution <250 m/pixel (orbits M00-M18)



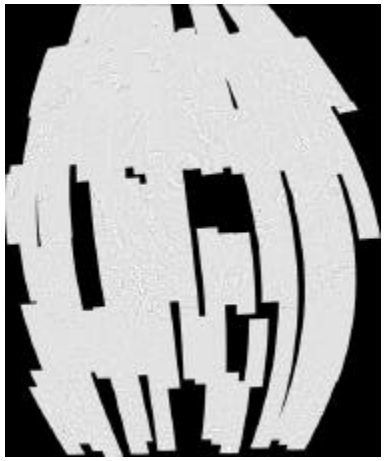


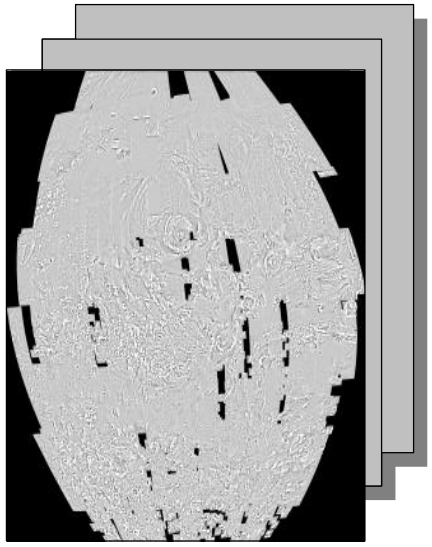
middle layer images of the Geodesy Campaign, resolution <250 m/pixel (orbit M01)



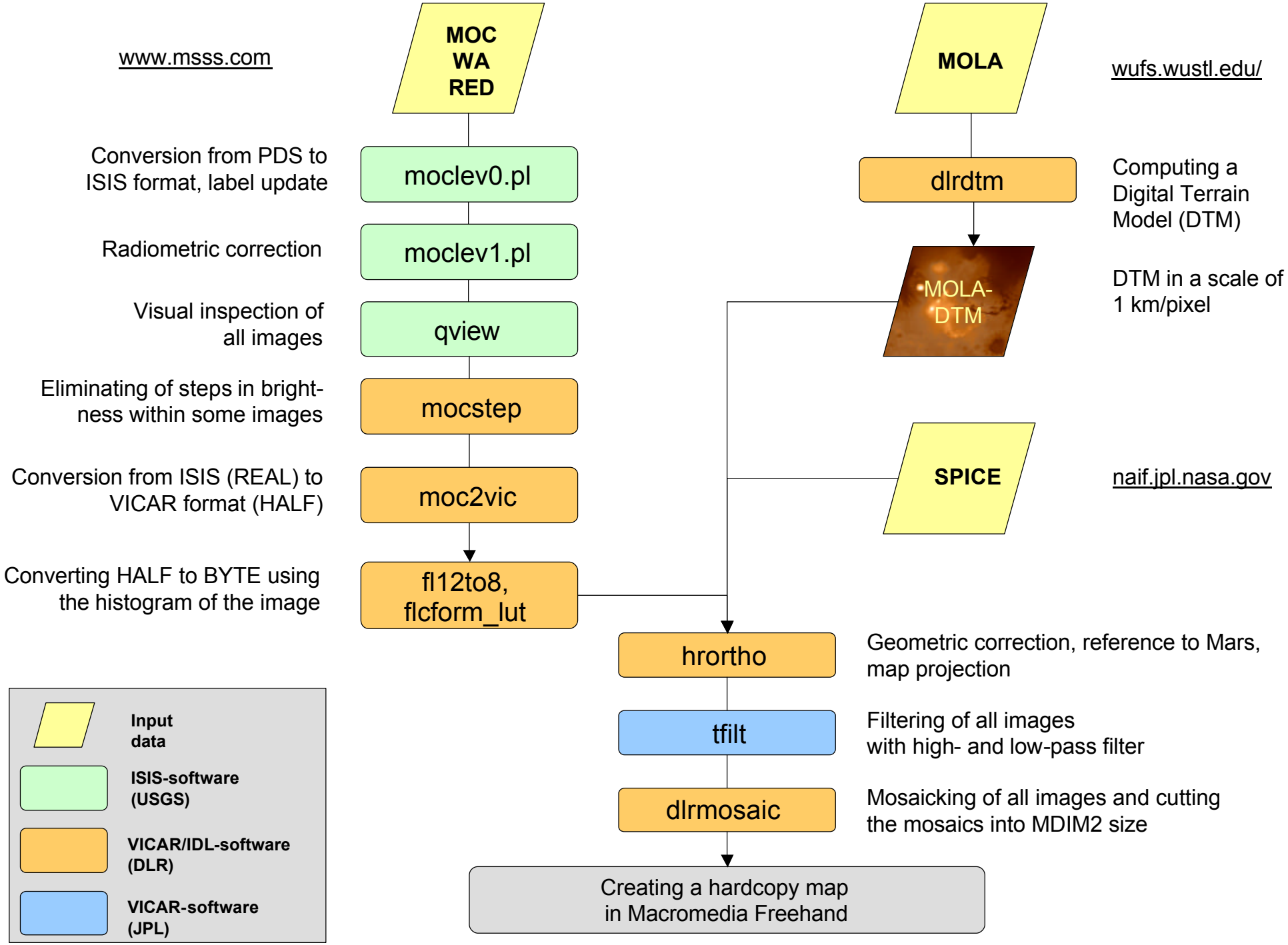


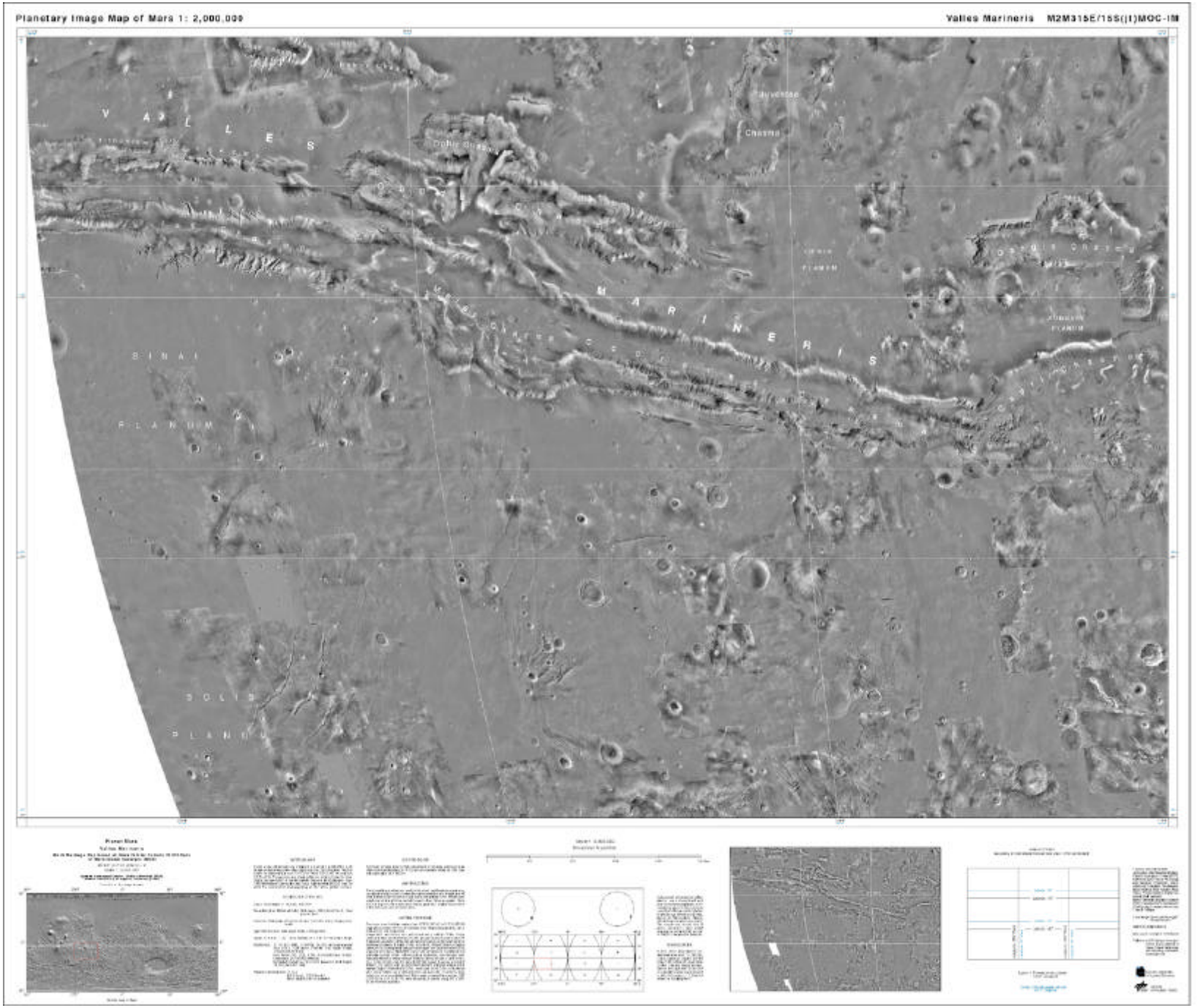
bottom layer images of the Geodesy Campaign, resolution >250 m/pixel, <435 m/pixel (orbit M01)





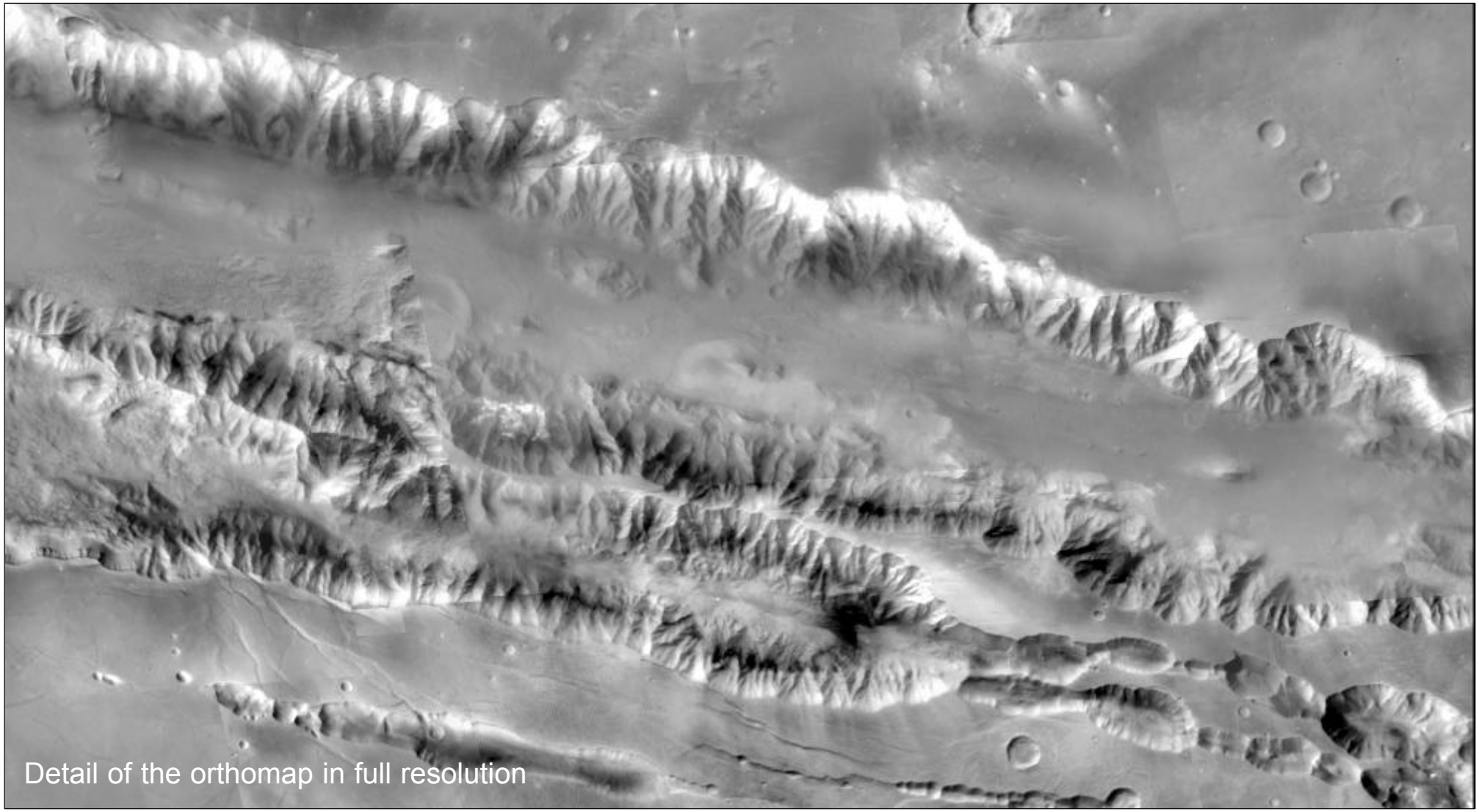
90° to 180° West


www.msss.com
MOC
WA
RED
MOLA
wufs.wustl.edu/
Conversion from PDS to ISIS format, label update
moclev0.pl
dlrdtm
Computing a Digital Terrain Model (DTM)
Radiometric correction
moclev1.pl
MOLA-DTM
DTM in a scale of 1 km/pixel
Visual inspection of all images
qview
Eliminating of steps in brightness within some images
mocstep
SPICE
naif.jpl.nasa.gov
Conversion from ISIS (REAL) to VICAR format (HALF)
moc2vic
Converting HALF to BYTE using the histogram of the image
fl12to8, flcform_lut
hrortho
Geometric correction, reference to Mars, map projection
tfilt
Filtering of all images with high- and low-pass filter
dlrmosaic
Mosaicking of all images and cutting the mosaics into MDIM2 size
Creating a hardcopy map in Macromedia Freehand
Input data
ISIS-software (USGS)
VICAR/IDL-software (DLR)
VICAR-software (JPL)



For comparisons with existing maps of Mars, the western part was subdivided into eight parts, according to MDIM2. Finally, latitude and longitude grids were added. The eight map parts with a resolution of 231.529 m/pixel are available digitally. The Valles Marineris part was cartographically processed and printed using a commercial oversize plotter on a scale of 1:2,000,000. The map field size is 0.89 m x 1.33 m.

SUMMARY AND CONCLUSIONS. We present a new digital map of Mars, which contributes an important step forward in the mapping of the planet. As the photometric conditions of the MOC and MDIM2 images are very different, it is still important to use both datasets for photogeological interpretations. We recognized that the accuracy of the navigation data has such a good quality, that the orthoimages fit very well to each other. The good correspondence between MOLA and MOC datasets can be seen by merging the MOC mosaic with the MOLA data using IHS-transformation (*next page*).



Detail of the orthomap in full resolution

MOC AND MDIM2 MERGED WITH MOLA